REMARKS

Initially, Applicant's attorney wishes to thank Examiners Flores-Ruiz and Ip for their courtesy in granting a recent interview at which there were discussed proposed amendments to cure the objections based upon the need for further structural definitions.

Independent Claims 1 and 10 now clearly define the combination of a coaxial laser producing a beam with a specified cross section, and an optical system providing a laser beam path therethrough which reforms the beam cross section into one which is more useful and efficient. That optical system essentially requires a specifically defined mirror. In addition, it will generally include other elements as defined in the dependent claims.

More particularly, the present invention provides a novel beam forming system which converts a laser beam exiting a coaxial laser from a circular sector shaped beam cross section into a laser beam with a rectangular cross section, and which minimizes image aberrations.

The system must include a mirror which has a reflective surface shaped in the form of a circular sector of a parabolic rotational body. A rotational paraboloid constitutes a special parabolic rotational body in which the axis of rotation coincides with the axis of symmetry of the parabola. A parabolic rotational body mirror generally produces on its axis of rotation a line focus if the axis of symmetry and the axis of rotation do not coincide. A rotational paraboloid mirror produces a point focus if its axis of rotation and axis of symmetry coincide.

Reflective surfaces in the form of circular sectors of parabolic rotational bodies shape the laser beam both in the azimuthal and radial directions with different focal lengths. They can even combine converging optical power in one direction with diverging optical power in the other. If there is precise parallelism between the laser beam axis and the optical axis, there will be no astigmatic distortions.

None of the prior art patents discloses the claimed combination and there is no suggestion therefor.

DE 44 21 600

In German patent DE 44 21 600, Anikitchev describes a laser beam forming system which converts a circular sector shaped laser beam with radial and/or azimuthal polarization into a rectangular laser beam with linear polarization (Column 1, lines 45-50).

The laser beam is shaped by means of a cone sector mirror (Column 2, lines 41-43) and a parabolic cylinder mirror which approximately coincides with the axis of rotation of the cone sector mirror (Column 2, lines 53-55).

To permit decoupling of the laser beam from the laser resonator, it is necessary to employ a cone sector mirror which the cone beam angle deviates slightly from 90°(column 3, lines 17-21) or for the cone axis to deviate somewhat from precise coincidence with the line focus of the parabolic cylinder mirror (Column 3, lines 35-39). As a result, only approximate rectangularity of the beam cross section and linearity of polarization can be obtained (Column 3, lines 29-32).

US 5,450,434

In US Patent No. 5,450,434, Ota discloses a method for working a cubic boron nitride article in which a beam having a wavelength of not longer than 360 nm is irradiating a surface of the article (Column 2, lines 32-38).

The term "cubic boron nitride article" is used to describe an article which is made essentially of cubic boron nitride, i.e., which comprises cubic boron nitride, or a portion of which is made of cubic boron nitride (Column 2, lines 38-41).

Ota discloses an excimer laser of F_2, ArF, KrCl, KrF, XeCl, N_2, or XeF, mercury vapor lamp, or synchrotron radiation as the beam source (Column 3, lines 42-44). The band width of the beam source may be narrowed by means of an optical filter or the line (Column 3, lines 54-55).

Several methods exist for parallelizing the beam emitted from the excimer laser and narrowing its band width, such as oscillation with an unstable resonator or narrowing the band width with either an etalon or prism and grating, and thereafter amplifying the narrowed beam (Column 4, lines 3-8).

US 6,285,703

Schlüter discloses a laser resonator with a coaxial discharge structure.

The laser resonator comprises first and second resonator mirrors and coaxial electrodes between which laser radiation is reflected back and forth in the direction of symmetry of the resonator.

The first resonator mirror has a generally toroidal concave reflective surface and the second resonator mirror has a generally conical reflective surface for deflecting laser radiation into azimuthally opposite regions of the reflective surface of the first resonator mirror (Column 7, lines 27-32).

The laser radiation travels from the toroidal mirror to the conical mirror, is then reflected over to the opposite side of the conical mirror, by which it is reflected again and travels towards the toroidal mirror. During its path from the toroidal mirror to the conical mirror and back, the laser radiation gains a slight angle, so that it does not hit the toroidal mirror at the starting point but a little to the side of this starting point. The laser radiation travels around the annular cross section before leaving the laser resonator at the outcoupling aperture in a small azimuthal area.

US 6,183,092

Troyer discloses a device for projecting laser beams by reflective liquid-crystal light valves to form pictures onto large viewing screens (Column 1, lines 7-10).

The laser projector apparatus comprises a red, green and blue laser and a cyan laser for best color mixing. Speckle is suppressed through beam-path displacement by scanning the beam or liquid-crystal valves (LCLVs)

The laser beam is shaped into a shallow cross-section which is shifted on the viewing screen.

US 3,868,637

Schiller discloses a document retrieval system that enables automatic, fast retrieval of a particular frame from a reel of microfilm through the punching in on a keyboard of

information concerning the document photographed on the microfilm frame (Column 1, lines 6-11).

In Figure 5, Schiller discloses an optical arrangement for forming the circular beam emitted from the light source (Column 11, line 37/Column 14, line 57).

The beam generating apparatus comprises light source means, first and second cylindrical lenses, a plate having an opening of a desired window reading configuration, and first and second spherical lenses (Column 19, lines 17-43). The two cylindrical lenses (42,44) convert a circular light beam into a collimated elliptical light beam having a second cross sectional area less than the first cross sectional area (Column 19, lines 23-27).

The two spherical lenses (48,50) serve to process and transmit the light passing through the slit (46) and reform that light as a reading window (58) on the plane of the film (28)(Column 12, lines 27-30).

The Prior Art Rejections are not Appropriate

The Examiner has rejected Claims 1-3, 6, 10 and 11 as being anticipated by Anikitchev (Sergej) German Patent DE 44 21 600.

The invention of the present patent application combines a coaxial laser with a beam forming system which must include a mirror whose surface is shaped as the circular sector of a reflective parabolic rotation body.

Clearly, Anikitchev does not disclose a beam forming mirror with a reflective surface shaped in the form of a circular sector of a parabolic body. Anikitchev discloses in Figure 1 a coaxial laser with an internal beam forming system. The coaxial laser comprises two resonator mirrors. The first resonator mirror 8 is designed as a conical mirror or a rotation paraboloid

(Column 2, lines 36-39) and the second resonator mirror 6 is designed on half of its circumference as a partly transparent mirror 6a and on the other part as a non-transparent mirror 6b (Column 2, lines 25-29). The beam forming system is made up of a first conical sector mirror 20 (Column 2, lines 41-43) and a second mirror 24, whose surface has a shape like a parabolic cylinder (Column 2, lines 53-55).

In the embodiment of Figure 11, Anikitchev discloses a beam forming system that is arranged in the resonator of a coaxial laser. The beam forming system consists of a first conical mirror 22 and a second parabolic cylinder mirror 24 (Column 3, Lines 56-58).

The mirrors of the beam forming system disclosed by Anikitchev are conical mirrors or parabolic cylinder mirrors, and not circular sector mirrors of a parabolic rotational body. Anikitchev discloses a rotation paraboloid mirror which acts as a resonator mirror, but not as beam forming mirror. Reflective surfaces in the form of circular sectors of parabolic rotational bodies shape the laser beam both in the azimuthal and radial direction. With only one mirror the circular shaped laser beam can be reformed into a rectangular laser beam. The beam forming system by Anikitchev requires the use of two mirrors. The cone sector mirror shapes the laser beam in the azimuthal direction, and for the focusing or defocusing of the laser beam in the radial direction, an additional mirror must be employed.

As to the proposed combination of Anikitchev and Ota to render obvious the subject matter of dependent claims 4-5 and 7-9, it is respectfully submitted that Ota may disclose optical systems with a filter or a lens, but he does not disclose or suggest the basic structure of Claims 1 and 10, and thus cure the deficiencies of Anikitchev. Although Ota discloses that several methods exist for parallelizing the band emitted from an excimer laser and narrowing

the band width. and discloses the use of different optical elements such as optical lenses or spatial filters, he does not disclose the use of a parabolic rotational body mirror that shapes a laser beam in the azimuthal and radial directions.

Schlüter discloses a coaxial laser resonator with a first conical resonator mirror and a second toroidal resonator mirror. The coaxial resonator mirror produces a laser beam having a circular sector shaped beam cross section.

Accordingly, it is respectfully submitted that the amended claims clearly define a novel and unobvious combination of a coaxial laser and a beam reforming optical system which produces a desirable and efficient laser beam with a rectangular cross section. Early allowance thereof is requested.

Respectfully submitted,

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